
Incidence of root fractures and methods used for post removal

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Abstract

Abbott PV. Incidence of root fractures and methods used for post removal. *International Endodontic Journal*, **35**, 63–67, 2002.

Aim This study was undertaken to determine the incidence of root fractures during post removal, as well as the methods used and the success rates achieved with various post removal devices and techniques.

Methodology Patient records from a specialist endodontic practice were examined. A total of 1600 teeth from which posts were removed were identified. These teeth had no preoperative signs or symptoms to suggest root fractures. The incidence of root fractures was determined and a subset of 234 patient records were examined in detail to determine the methods used to remove different types of posts.

Results Only one tooth fractured during post removal (0.06%) and all posts were successfully removed, typically in about 3 min. Most cast posts were removed with an Egglar post remover but some dislodged when the crown was removed; ultrasonics was used occasionally. Most parallel-sided posts were removed with ultrasonics and threaded posts were unscrewed. The Masserann kit and ultrasonics were combined to remove fractured cast posts and some parallel-sided posts.

Conclusions This study indicates that, with good case selection, post removal is a predictable procedure. If appropriate techniques and devices are used for the particular type of post being removed, then root fracture is a rare occurrence.

Keywords: fractures, post removal, posts.

Received 11 December 2000; accepted 6 March 2001

Introduction

The dental literature contains little information about the removal of posts from teeth that require root canal re-treatment. Most of the articles are either case reports or descriptions of various techniques. Many dentists believe that removing posts can lead to root fractures and this appears to be a major reason why many practitioners avoid this procedure. A survey of American endodontists (Stamos & Gutmann 1993) indicated that many of the respondents thought post removal devices were too dangerous, could not be used universally, or they did not work. The presence of a post in a root was also a common reason for respondents to recommend periapical surgery to treat failed cases rather than attempting to remove the post and complete root canal re-treatment, even though

the success rate of re-treatment is considered to be higher than for surgery (Allen *et al.* 1989, Molven *et al.* 1991). Some of the more common reasons stated by American endodontists (Stamos & Gutmann 1993) for recommending surgery instead of removing a post included an 'intact post and crown' (63%), to 'avoid root fracture/perforation' (57%), a 'large/long/threaded post' (28%), and 'cannot remove post after reasonable effort' (88%). In contrast, a recent survey of endodontists in Australia and New Zealand reported rather different attitudes toward post removal and this was positively correlated to the institution at which they had done their specialty training in endodontics (Castrisio & Abbott 2002). The respondents to this survey indicated that post removal was a common procedure and they were not overly concerned about root fracture.

The concern of dental practitioners toward post removal appears to be related to empirical attitudes developed at dental school rather than being related to any scientific evidence. Only two studies have investigated the safety of

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post removal devices (Altshul *et al.* 1997, Castrisos *et al.* 2001), but the empirical attitudes have been discussed for many years. Altshul *et al.* (1997) showed more cracks in dentine following the use of ultrasonic vibration to loosen posts, whilst Castrisos *et al.* (2002) showed that the Egger post remover was a safe device provided it was used correctly and the post was withdrawn parallel to the long axis of the tooth root.

Orthograde root canal re-treatment is a common procedure. In a study of 2000 patients treated in an endodontic practice, Abbott (1994) reported that 36.7% of the cases required re-treatment and 25.7% of these initially needed post removal. This represented 9.4% of all cases treated and demonstrates that endodontists have to be proficient at removing posts. In order to be proficient, practitioners must have several different devices and techniques available to suit the various types of posts that may require removal. Practitioners must also be confident about selecting cases that can be treated successfully by removal of the posts.

The aim of this study was to determine how successful various post removal techniques were and to determine the incidence of root fractures during post removal in a cohort of patients attending a specialist endodontic practice.

Materials and methods

This study was conducted in two parts. Part one was a review of patient records for teeth that had posts removed and these were identified by a computer search of treatment codes used for billing purposes. In order to be included, each tooth must have had no clinical or radiographic signs or symptoms and in particular no deep, narrow periodontal pockets to suggest the presence of a root fracture prior to post removal. As part of the author's routine procedures following post removal, all teeth were re-examined for the presence of root fractures by trans-

illuminating the tooth root with a fibre-optic light from as many different angles as possible. This was done immediately after post removal and at all subsequent appointments during the endodontic re-treatment and follow-up examinations. Periodontal probing was also routinely carried out at subsequent appointments to assess whether any root fractures had occurred. These cases were analysed to determine how many of the posts could be removed and how many roots fractured during post removal. In all, 1600 teeth were identified for inclusion in part one.

In the second part of the study, a more detailed analysis of a sample of 234 of these 1600 teeth was carried out at the time of post removal. These cases were consecutive cases analysed in a prospective manner during a two-year period to determine the tooth type, the type of post being removed, the device and method used to remove the post, and the time taken to remove the post and core. They were also analysed in the same manner as the other teeth in the first part of the study to determine whether any roots had fractured during post removal.

Results

All of the 1600 posts were successfully removed and only one root (0.06%) fractured during post removal. Tables 1–4 summarize the results of the more detailed analysis of the 234 teeth in the second part of the study.

Table 1 Frequency and types of posts removed in part 2 of the study

Post type	No.	%
Cast post/core	154	65.8
Preformed parallel-sided posts	69	29.5
Threaded posts	10	4.3
Flexiposts	1	0.4
Total	234	100.0

Tooth group	Cast	Parallel	Threaded	Flexipost	Totals
<i>Maxillary:</i>					
Incisors + canines	110 (47.0)	32 (13.7)	2 (0.9)	–	144 (61.6)
Premolars	20 (8.6)	13 (5.6)	–	–	33 (14.2)
Molars	2 (0.9)	3 (1.3)	4 (1.7)	–	9 (3.8)
<i>Mandibular:</i>					
Incisors + canines	9 (3.8)	1 (0.4)	–	1 (0.4)	11 (4.7)
Premolars	9 (3.8)	4 (1.7)	3 (1.3)	–	16 (6.8)
Molars	4 (1.7)	16 (6.8)	1 (0.4)	–	21 (8.9)
Totals	154 (65.8)	69 (29.5)	10 (4.3)	1 (0.4)	234 (100)

Figures in parentheses are percentages.

Table 2 Types of posts used in various tooth groups

Table 3 Frequency of use of various post removal devices and techniques

Method	No. of teeth	%
Eggler post remover	96	41.0
Ultrasonics alone	48	20.5
Masserann + ultrasonics	25	10.7
Post came out with crown	56	23.9
Unscrewed with orthodontic pliers	9	3.8
Total	234	100.0

The type of post present in each tooth was identified radiographically prior to removal and then confirmed upon removal. Posts were classified as being cast posts/cores, preformed parallel-sided posts, threaded posts or Flexiposts. The cast post/core group included all customized posts made by casting the entire unit with either gold or a non-precious metal. The preformed parallel-sided post group comprised cases where commercially available parallel-sided posts had been used and where there was no evidence of a cast core; instead, the cores had been built up with either amalgam or composite resin materials. Tapered posts with a thread for screwing into the tooth root were designated as threaded posts, and one tooth had a flexible metal post, commercially known as a Flexipost (Essential Dental Systems, South Hackensack, NJ, USA). Flexiposts have a split shank with parallel sides and a thread. It was not possible to determine the manufacturer of individual posts, apart from the Flexipost, as the designs and materials used by most manufacturers were very similar. The type of post used in each tooth had been chosen by the dentists who had restored them and hence many different brands were used.

When analysing the time taken to remove posts, those posts that were removed along with the crown in one unit were designated as taking 0 min, and for all other posts the time taken included the time required to remove the core filling material surrounding the post, or the time taken to shape cast cores to allow application of the post removal device. The mean time required to remove the 234 posts was 6.5 min, the mode was 3 min and the range was 0–30 min.

Discussion

Orthograde root canal re-treatment is the author's preferred treatment approach when managing previously root-filled teeth with evidence of infected canals and apical periodontitis (Abbott 1999). This is true even if a post is present in the tooth, since the outcome of this treatment is more predictable and more successful than for retrograde/surgical treatment (Allen *et al.* 1989, Molven *et al.* 1991). However, there are instances when this approach is not followed and surgery may be recommended. Typically, this occurs when there is a very wide post in a thin root, where the tooth may not be restorable again, when a tooth has been recently restored with a post/crown and where the infection may have been present prior to this restoration being placed, and occasionally for financial reasons. These reasons for not removing a post are consistent with those reported in a recent survey of Australian and New Zealand endodontists (Castrisio & Abbott 2002). In these cases, the treatment code for post removal would not be used for billing purposes and hence these teeth were not identified by the computer search for inclusion in this study. Therefore, the sample of teeth studied is, to some extent, a biased sample in that not all teeth with posts were included and teeth that were identified as being predisposed to root fracture did not have post removal attempted. Case selection is an extremely important aspect of clinical practice that requires skill and experience combined with a thorough assessment of each individual case prior to treatment. Hence this study was essentially a study of teeth that were deemed to be suitable for post removal and further restoration. Teeth from all tooth groups and both arches were included (Table 2).

The teeth included in the first part of the study were examined prior to post removal as part of the routine endodontic examination to determine whether there were any signs or symptoms suggestive of a root fracture. They were assessed again after post removal and then at each subsequent appointment in case a root fracture had not been detected immediately post removal. The classic signs of a root fracture include looseness of the post and restoration, regular dislodgement of the restoration, and

Table 4 Methods and devices used to remove each particular type of post

Method	Cast	Parallel	Threaded	Flexipost	Totals
Eggler post remover	91 (39.0)	5 (2.1)	–	–	96 (41.0)
Ultrasonics alone	9 (3.8)	39 (16.7)	–	–	48 (20.5)
Masserann + ultrasonics	5 (2.1)	19 (8.1)	–	1 (0.4)	25 (10.7)
Came out with crown	49 (20.9)	6 (2.6)	1 (0.4)	–	56 (23.9)
Unscrewed with pliers	–	–	9 (3.8)	–	9 (3.8)
Totals	154 (65.8)	69 (29.5)	10 (4.3)	1 (0.4)	234 (100)

the presence of a deep narrow periodontal pocket. Many cases will have two deep narrow periodontal pockets on opposite sides of the tooth root. Tenderness to biting pressure, tenderness to percussion, and increased mobility of the tooth can also be indicative of a root fracture, but these signs could also be associated with apical periodontitis due to infected root canals. Radiographs can also help to identify root fractures either due to the presence of a fracture line or by a general widening of the periodontal ligament space along most of the root, and especially in the coronal portion, on at least one side of the tooth. In most, but not all cases, the widened ligament space will be present on both sides of the root although it may not extend all the way to the apex. The presenting signs will depend on the position and extent of the fracture or crack so there can be many variations in the signs and symptoms.

Only one of the 1600 teeth (0.06%) developed a root fracture during post removal, which indicates that root fractures are not very likely to occur with good case selection and with the techniques used in this study. This figure is slightly higher than the estimate of 0.002% reported in the survey of Australian and New Zealand endodontists (Castrisio & Abbott 2002) but it still demonstrates an extremely low risk for root fracture during post removal. These figures do not support the fears of many American endodontists (Stamos & Gutmann 1993) and the commonly stated empirical claims that root fractures are likely when posts are being removed.

Various techniques were used to remove the posts and these were similar to the techniques used by other Australian and New Zealand endodontists (Castrisio & Abbott 2002). The details recorded in the second part of the study demonstrated that the method chosen largely depended on the type of post being removed. In the sample of 234 teeth examined, cast posts/cores were the most common (65.8%) type of post removed and three-quarters of these were removed from upper incisors and canines. Most of the cast posts (59.1%) were removed with an Egger post remover. The technique generally used by the author for these cases may have included some loosening of the post by ultrasonic vibration. An ultrasonic scaler was applied to the core portion of the casting after removing the crown in order to remove any of the crown luting cement left on the surface of the core. This sufficiently loosened a few cast posts (5.8%) to remove them without any further device being applied. The Egger device can be easily applied to anterior teeth and to most first premolar teeth, but its size prevents it from being used in most second premolars and virtually all molar teeth – fortunately, very few cast posts were used in these teeth.

When the Egger post remover is to be used, the core must be reduced to a cube-shape with approximate dimensions of 2 mm for each side in order to allow the forceps arms of the Egger device to be applied. This reduction was completed with a high speed bur which may produce some vibratory action along the post and this may help to break down the adhesion of the luting cement between the post and canal wall.

Many cast posts/cores (31.8%) were removed with the crown and hence did not require any form of post removal device to be used. This is likely to be an indication that the luting cement had broken down or had dissolved over time due to leakage of the restoration margins. Apart from making it easy to remove the post, the presence of leakage reinforces the need to remove the restoration and the post in order to remove the aetiological factor causing the infection within the canal – this in turn reinforces the need for conventional re-treatment rather than periapical surgery.

The remaining 3.3% of cast posts had fractured within the canal and were removed with a combination of the Masseran kit (Micro-Mega SA, Besançon, Cedex, France) and ultrasonic vibration. In these cases, the two devices were used alternately until the post could be removed. The Masseran trepan burs were applied in a low speed handpiece used in the reverse direction (Masseran 1971) and advanced approximately 0.25–0.5 mm at a time. Ultrasonic vibration was applied subsequently to loosen the post and flush debris from the canal. The aim of this technique was to move the fulcrum point toward the apical end of the post, whilst also trying to break down the cement adhesion between the post and the dentine. Removal of some of the cement also provided space for application of the ultrasonic instrument tip and space into which the post could begin to move when being vibrated (Abbott 1996).

Preformed parallel-sided posts were removed from teeth of all tooth groups in both arches, although almost half (46.4%) of them were removed from upper incisors and canines. Lower molars (23.2%) and upper premolars (18.8%) were the next most common tooth groups with these posts. Approximately half (56.5%) of all the preformed parallel-sided posts were removed with ultrasonics alone and about a quarter (27.5%) were removed with a combination of the Masseran kit and ultrasonic vibration, using the technique outlined above. Some were removed with the crown (8.7%), and the Egger device was used for a few (7.3%) very large parallel-sided posts. Threaded posts were simply removed with the aid of orthodontic pliers to grasp the core. One Flexipost was identified in this study and it was removed with a combination of the Masseran kit and ultrasonic vibration.

In the survey of American endodontists by Stamos & Gutmann (1993), post removal devices were not commonly used by the respondents because they were concerned about inducing root fractures and they felt the devices were dangerous or did not work. Instead, most of the respondents used haemostats (67%) or drilled the posts out with burs (62%). In view of the concerns about the dangers of post removal devices, these figures are somewhat surprising and alarming, since these two methods are considered even more dangerous and prone to complications. Removing a post with haemostats could result in extraction of the tooth, whilst drilling a post out with a bur is likely to lead to unnecessary removal of tooth structure. It is very difficult to control a high-speed bur within a confined space in such a way that it only cuts the post and not dentine. An end-cutting bur would be needed but these burs have a propensity to 'slip' off the surface that they are cutting and hence may gouge the root canal walls. Considerable weakening of the tooth could occur and this could ultimately lead to root fracture or render the tooth unsuitable for further restoration.

Using the techniques outlined in this study, post removal was predictable, safe, and expedient. The figure for the average time (6.5 min) was probably reduced by the number of posts that dislodged with the crowns (23.9%, designated as 0 min) and hence the mode (3 min) may be a more relevant time to consider. The time recorded included the time taken to remove the core filling material surrounding preformed posts and the time needed to reduce cast cores to fit the Egger device. The times varied considerably and there was no particular pattern to the time required for any particular type of post. The time taken probably depended more on the type of luting cement used, the type of core filling material surrounding preformed posts, and the type of metal used for cast posts/cores. In general, when removing a post, the type of luting cement is not usually known, but resin-based cements are considered to be more difficult to remove than cements such as zinc phosphate. Composite resin cores may also be more difficult to remove than amalgam cores, and cast gold cores are usually easier to remove than cores made with non-precious metals.

Conclusion

In summary, this study has demonstrated that posts can be safely, predictably and quickly removed from teeth in order to allow root canal re-treatment and/or new restorations to be provided. As a result of this, the presence of a post in a tooth root should not be considered as an indication in itself for periapical surgery. Root fractures are unlikely to occur with good case selection provided appropriate devices and techniques are chosen; the choice of these should be based on the type of post to be removed.

References

- Abbott PV (1994) Analysis of a referral based endodontic practice. Part 2: Treatment provided. *Journal of Endodontics* **20**, 253–7.
- Abbott PV (1996) Failures, disasters and catastrophes – a hypothetical. *Annals of the Royal Australasian College of Dental Surgeons* **13**, 79–98.
- Abbott PV (1999) A retrospective analysis of the reasons for, and the outcome of, conservative endodontic re-treatment and periradicular surgery. *Australian Dental Journal* **44** (Special Suppl.), S3–4.
- Allen RK, Newton CW, Brown CE (1989) A statistical analysis of surgical and non-surgical endodontic retreatment cases. *Journal of Endodontics* **15**, 261–6.
- Altshul JH, Marshall G, Morgan LA, Baumgartner JC (1997) Comparison of dentinal crack incidence and of post removal time resulting from post removal by ultrasonic or mechanical force. *Journal of Endodontics* **23**, 683–6.
- Castrisio T, Abbott PV (2002) A survey of methods used for post removal in specialist endodontic practice. *International Endodontic Journal* (in press).
- Castrisio T, Palamara JEA, Abbott PV (2002) Measurement of strain on tooth roots during post removal with the Egger post remover. *International Endodontic Journal* (in press).
- Masserann J (1971) Technique for the removal of metallic fragments which remain lodged in root canals. *Journal of the British Endodontic Society* **5**, 55–9.
- Molven O, Halse H, Grung B (1991) Surgical management of endodontic failures: indications and treatment results. *International Dental Journal* **41**, 33–42.
- Stamos DE, Gutmann JL (1993) Survey of endodontic retreatment methods used to remove intraradicular posts. *Journal of Endodontics* **19**, 366–9.